

CITY OF HELENA
CENTENNIAL PARK
SOIL MOISTURE MONITORING PLAN



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CITY OF HELENA

CENTENNIAL PARK

SOIL MOISTURE MONITORING PLAN

LIST OF APPENDICES

Prepared for:

APPENDIX A. DAILY EVAPOTRANSPIRATION
APPENDIX B. EXAMPLE OF CHECKBOOK
APPENDIX C. MAINTENANCE AND INSPECTION SYSTEM

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CITY OF HELENA

CENTENNIAL PARK

SOIL MOISTURE MONITORING PLAN

1.0 INTRODUCTION

Centennial Park is located over the abandoned City of Helena landfill north of Lyndale Avenue and west of North Main Street. In the summer of 1988, the City of Helena installed an irrigation system and began development of grass-covered soccer and baseball playing fields in the park. The purpose of this monitoring plan is to monitor movement of irrigation water from Centennial Park into the underlying soil. The City of Helena watering program is designed to provide adequate water for the grass without applying excess water that could percolate downward into the underlying refuse.

Key elements of this monitoring plan are:

- 1) weekly inspection of the irrigation system to check for leaks, *See app C*
- 2) weekly record of water use to detect leaks in the irrigation system piping, *app C*
- 3) maintenance of a logbook of irrigation schedules including irrigation rates and duration of irrigation,

- 4) soil moisture monitoring using a neutron probe and a Paul Brown type soil probe.

2.0 MAINTENANCE AND INSPECTION OF IRRIGATION SYSTEM

Inspection of the irrigation system will be conducted weekly to detect leaks in the system. Inspection will be limited to those parts of the system accessible from the surface: sprinkler heads, control valves, and water meter. The procedure for inspection of the system is detailed in Appendix C. The system inspector will complete a standard form detailing results of the inspection, the condition of the irrigation system, and describing any needed system maintenance. Copies of the inspection results will be submitted to the park supervisor.

3.0 CHECKBOOK IRRIGATION SCHEDULING

The objectives of the Helena Soccer Field irrigation system are to achieve a water management budget that is conducive to rapid plant growth, yet will not allow deep percolation of water past the plant rooting depth and consequently into the waste material in the underlying landfill.

Grass planted over the old landfill is a mixture of Sheep fescue, Scalds hard fescue, Western wheatgrass and barren Kentucky bluegrass. A good estimate for the consumptive use of grass mixtures is given in

the Irrigation Guide for Montana (USDA, 1971). Also, estimates of consumptive use can be made by using methods such as Blaney-Criddle, Jensen-Haise and the Penman equation. These methods calculate evapotranspiration depending upon environmental factors such as solar radiation, wind, temperature and humidity. Soil type and plant type also play a critical role in water evapotranspiration.

By scheduling irrigations, water can be added to a crop without over watering (allowing excessive deep percolation) and without crop stress. This would accomplish the irrigation objectives. However, since irrigation scheduling estimates water usage, soil moisture measurements must be obtained from representative site locations to allow calibration of the irrigation scheduling method and to assure that no water is percolating into the underlying landfill.

A simple, accurate method for irrigation scheduling is available and is known as the Checkbook Irrigation Scheduling Method. Evapotranspiration is estimated using one of several methods and a soil water balance is kept on a daily basis.

First, the evapotranspiration must be estimated for the Checkbook Method. Although the Blaney-Criddle Method for determining evapotranspiration is the simplest, the Jensen-Haise Method is more accurate for daily crop water use estimates (Smith, 1983). By tabulating daily solar radiation values in conjunction with daily average temperature, consumptive use can be estimated for a particular

crop using the Jensen-Haise Method. This consumptive use can be used in the Checkbook Method and a soil water balance can be calculated.

As shown in Appendix A, an average daily temperature is recorded, and crop water use is estimated (based on the Jensen-Haise Method). This estimated crop water use is then added to the soil water deficit determined at the beginning of the irrigation season. If any precipitation occurs, it is subtracted from the soil water deficit (see Appendix B for step-by-step instructions and an example). In the City of Helena, precipitation and average daily temperature can be obtained easily by calling the Helena Airport weather station.

Once the soil water deficit reaches a pre-specified value, irrigation is initiated. The amount of time which the field is irrigated will be based on the application rate of the sprinklers and the pre-specified soil water deficit limit. These values can be easily determined at the beginning of the irrigation season.

3.1 SOIL MOISTURE MONITORING

Because crop water use is very site-specific, it is recommended that soil moisture measurements be made to calibrate and check the Checkbook Method. This will determine actual crop water use and will ensure that no water is percolating beneath the root zone into the underlying landfill material.

Soil moisture can be measured by several methods. A tensiometer has been used onsite somewhat ineffectively because tensiometers only measure a small spectrum of a soil moisture curve. Resistance blocks could also be used but are adversely affected by poor water quality. Neutron meters can very accurately measure soil moisture throughout the soil column. Using this method, a probe is lowered into an access tube placed in the soil. The probe contains a source of high energy neutrons which are thermalized by hydrogen in water. These thermalized neutrons are then counted by the instrument and the soil water content is determined.

By placing four small diameter neutron access ports at depth to about 5 feet at representative sites in soccer and baseball fields as shown on Plate 1, the Checkbook Scheduling Method can be calibrated. Ports would be buried belowgrade so as not to limit playing field activity. Additionally, the Paul Brown type soil probe will be used in 15 to 30 locations across the site to independently check the accuracy of the irrigation scheduling method and for correlation of soil moisture with the neutron probe. It is estimated that using the neutron probe for one irrigation season will allow calibration of the Checkbook Method and Paul Brown probe. In years following, the Paul Brown soil probe and Checkbook method should be sufficient.

Soil moisture readings will be taken once every 2 weeks with the neutron probe. These readings will then be compared with the values determined with the irrigation scheduling method and adjustments can be made to the soil water deficit and crop coefficient.

4.0 REFERENCES

Smith, J.L., 1983. Irrigation Principles. Interdepartmental Paper. Agricultural Engineering Department, University of Wyoming, Laramie, Wyoming.

U.S. Department of Agriculture, Soil Conservation Service, 1971. Irrigation Guide for Montana. U.S.D.A.

Wyoming Water Resources Center, 1983. Report Number 5. University of Wyoming, Laramie, Wyoming.

APPENDIX A.

DAILY EVAPOTRANSPIRATION POTENTIAL

APPENDIX A
APRIL- ET POTENTIAL

AVE. TEMP DEG F	AVE. TEMP DEG C	ET POTENTIAL INCHES
33.00	1.67	0.09
36.00	2.22	0.09
37.00	2.78	0.10
38.00	3.33	0.10
39.00	3.89	0.11
40.00	4.44	0.11
41.00	5.00	0.11
42.00	5.56	0.12
43.00	6.11	0.12
44.00	6.67	0.13
45.00	7.22	0.13
46.00	7.78	0.14
47.00	8.33	0.14
48.00	8.89	0.15
49.00	9.44	0.15
50.00	10.00	0.16
51.00	10.56	0.16
52.00	11.11	0.17
53.00	11.67	0.17
54.00	12.22	0.18
55.00	12.78	0.18
56.00	13.33	0.19
57.00	13.89	0.19
58.00	14.44	0.20
59.00	15.00	0.20
60.00	15.56	0.20
61.00	16.11	0.21
62.00	16.67	0.21
63.00	17.22	0.22
64.00	17.78	0.22
65.00	18.33	0.23
66.00	18.89	0.23
67.00	19.44	0.24
68.00	20.00	0.24
69.00	20.56	0.25
70.00	21.11	0.25
71.00	21.67	0.26
72.00	22.22	0.26
73.00	22.78	0.27
74.00	23.33	0.27
75.00	23.89	0.28
76.00	24.44	0.28
77.00	25.00	0.28
78.00	25.56	0.29
79.00	26.11	0.29
80.00	26.67	0.30
81.00	27.22	0.30
82.00	27.78	0.31
83.00	28.33	0.31
84.00	28.89	0.32
85.00	29.44	0.32
86.00	30.00	0.33
87.00	30.56	0.33
88.00	31.11	0.34
89.00	31.67	0.34
90.00	32.22	0.35

APPENDIX A
MAY- ET POTENTIAL

AVE. TEMP DEG F	AVE. TEMP DEG C	ET POTENTIAL INCHES
35.00	1.67	0.10
36.00	2.22	0.10
37.00	2.78	0.11
38.00	3.33	0.11
39.00	3.89	0.12
40.00	4.44	0.13
41.00	5.00	0.13
42.00	5.56	0.14
43.00	6.11	0.14
44.00	6.67	0.15
45.00	7.22	0.15
46.00	7.78	0.16
47.00	8.33	0.16
48.00	8.89	0.17
49.00	9.44	0.17
50.00	10.00	0.18
51.00	10.56	0.18
52.00	11.11	0.19
53.00	11.67	0.20
54.00	12.22	0.20
55.00	12.78	0.21
56.00	13.33	0.21
57.00	13.89	0.22
58.00	14.44	0.22
59.00	15.00	0.23
60.00	15.56	0.23
61.00	16.11	0.24
62.00	16.67	0.24
63.00	17.22	0.25
64.00	17.78	0.25
65.00	18.33	0.26
66.00	18.89	0.27
67.00	19.44	0.27
68.00	20.00	0.28
69.00	20.56	0.28
70.00	21.11	0.29
71.00	21.67	0.29
72.00	22.22	0.30
73.00	22.78	0.30
74.00	23.33	0.31
75.00	23.89	0.31
76.00	24.44	0.32
77.00	25.00	0.32
78.00	25.56	0.33
79.00	26.11	0.34
80.00	26.67	0.34
81.00	27.22	0.35
82.00	27.78	0.35
83.00	28.33	0.36
84.00	28.89	0.36
85.00	29.44	0.37
86.00	30.00	0.37
87.00	30.56	0.38
88.00	31.11	0.38
89.00	31.67	0.39
90.00	32.22	0.39

APPENDIX A
JUNE- ET POTENTIAL

AVE. TEMP DEG F	AVE. TEMP DEG C	ET POTENTIAL INCHES
35.00	1.67	0.11
36.00	2.22	0.11
37.00	2.78	0.12
38.00	3.33	0.13
39.00	3.89	0.13
40.00	4.44	0.14
41.00	5.00	0.14
42.00	5.56	0.15
43.00	6.11	0.16
44.00	6.67	0.16
45.00	7.22	0.17
46.00	7.78	0.17
47.00	8.33	0.18
48.00	8.89	0.19
49.00	9.44	0.19
50.00	10.00	0.20
51.00	10.56	0.20
52.00	11.11	0.21
53.00	11.67	0.21
54.00	12.22	0.22
55.00	12.78	0.23
56.00	13.33	0.23
57.00	13.89	0.24
58.00	14.44	0.24
59.00	15.00	0.25
60.00	15.56	0.26
61.00	16.11	0.26
62.00	16.67	0.27
63.00	17.22	0.27
64.00	17.78	0.28
65.00	18.33	0.29
66.00	18.89	0.29
67.00	19.44	0.30
68.00	20.00	0.30
69.00	20.56	0.31
70.00	21.11	0.32
71.00	21.67	0.32
72.00	22.22	0.33
73.00	22.78	0.33
74.00	23.33	0.34
75.00	23.89	0.34
76.00	24.44	0.35
77.00	25.00	0.36
78.00	25.56	0.36
79.00	26.11	0.37
80.00	26.67	0.37
81.00	27.22	0.38
82.00	27.78	0.39
83.00	28.33	0.39
84.00	28.89	0.40
85.00	29.44	0.40
86.00	30.00	0.41
87.00	30.56	0.42
88.00	31.11	0.42
89.00	31.67	0.43
90.00	32.22	0.43

APPENDIX A
JULY- ET POTENTIAL

AVE. TEMP DEG F	AVE. TEMP DEG C	ET POTENTIAL INCHES
35.00	1.67	0.10
36.00	2.22	0.11
37.00	2.78	0.11
38.00	3.33	0.12
39.00	3.89	0.12
40.00	4.44	0.13
41.00	5.00	0.13
42.00	5.56	0.14
43.00	6.11	0.14
44.00	6.67	0.15
45.00	7.22	0.16
46.00	7.78	0.16
47.00	8.33	0.17
48.00	8.89	0.17
49.00	9.44	0.18
50.00	10.00	0.18
51.00	10.56	0.19
52.00	11.11	0.19
53.00	11.67	0.20
54.00	12.22	0.21
55.00	12.78	0.21
56.00	13.33	0.22
57.00	13.89	0.22
58.00	14.44	0.23
59.00	15.00	0.23
60.00	15.56	0.24
61.00	16.11	0.24
62.00	16.67	0.25
63.00	17.22	0.25
64.00	17.78	0.26
65.00	18.33	0.27
66.00	18.89	0.27
67.00	19.44	0.28
68.00	20.00	0.29
69.00	20.56	0.29
70.00	21.11	0.29
71.00	21.67	0.30
72.00	22.22	0.30
73.00	22.78	0.31
74.00	23.33	0.32
75.00	23.89	0.32
76.00	24.44	0.33
77.00	25.00	0.33
78.00	25.56	0.34
79.00	26.11	0.34
80.00	26.67	0.35
81.00	27.22	0.35
82.00	27.78	0.36
83.00	28.33	0.37
84.00	28.89	0.37
85.00	29.44	0.38
86.00	30.00	0.38
87.00	30.56	0.39
88.00	31.11	0.39
89.00	31.67	0.40
90.00	32.22	0.40

APPENDIX A
AUG- ET POTENTIAL

AVE. TEMP DEG F	AVE. TEMP DEG C	ET POTENTIAL INCHES
35.00	1.67	0.09
36.00	2.22	0.09
37.00	2.78	0.10
38.00	3.33	0.10
39.00	3.89	0.10
40.00	4.44	0.11
41.00	5.00	0.11
42.00	5.56	0.12
43.00	6.11	0.12
44.00	6.67	0.13
45.00	7.22	0.13
46.00	7.78	0.14
47.00	8.33	0.14
48.00	8.89	0.15
49.00	9.44	0.15
50.00	10.00	0.16
51.00	10.56	0.16
52.00	11.11	0.17
53.00	11.67	0.17
54.00	12.22	0.18
55.00	12.78	0.18
56.00	13.33	0.18
57.00	13.89	0.19
58.00	14.44	0.19
59.00	15.00	0.20
60.00	15.56	0.20
61.00	16.11	0.21
62.00	16.67	0.21
63.00	17.22	0.22
64.00	17.78	0.22
65.00	18.33	0.23
66.00	18.89	0.23
67.00	19.44	0.24
68.00	20.00	0.24
69.00	20.56	0.25
70.00	21.11	0.25
71.00	21.67	0.26
72.00	22.22	0.26
73.00	22.78	0.27
74.00	23.33	0.27
75.00	23.89	0.27
76.00	24.44	0.28
77.00	25.00	0.28
78.00	25.56	0.29
79.00	26.11	0.29
80.00	26.67	0.30
81.00	27.22	0.30
82.00	27.78	0.31
83.00	28.33	0.31
84.00	28.89	0.32
85.00	29.44	0.32
86.00	30.00	0.33
87.00	30.56	0.33
88.00	31.11	0.34
89.00	31.67	0.34
90.00	32.22	0.35

APPENDIX A
SEPT- ET POTENTIAL

AVE. TEMP DEG F	AVE. TEMP DEG C	ET POTENTIAL INCHES
35.00	1.67	0.07
36.00	2.22	0.07
37.00	2.78	0.08
38.00	3.33	0.08
39.00	3.89	0.08
40.00	4.44	0.09
41.00	5.00	0.09
42.00	5.56	0.09
43.00	6.11	0.10
44.00	6.67	0.10
45.00	7.22	0.11
46.00	7.78	0.11
47.00	8.33	0.11
48.00	8.89	0.12
49.00	9.44	0.12
50.00	10.00	0.12
51.00	10.56	0.13
52.00	11.11	0.13
53.00	11.67	0.14
54.00	12.22	0.14
55.00	12.78	0.14
56.00	13.33	0.15
57.00	13.89	0.15
58.00	14.44	0.16
59.00	15.00	0.16
60.00	15.56	0.16
61.00	16.11	0.17
62.00	16.67	0.17
63.00	17.22	0.17
64.00	17.78	0.18
65.00	18.33	0.18
66.00	18.89	0.19
67.00	19.44	0.19
68.00	20.00	0.19
69.00	20.56	0.20
70.00	21.11	0.20
71.00	21.67	0.20
72.00	22.22	0.21
73.00	22.78	0.21
74.00	23.33	0.22
75.00	23.89	0.22
76.00	24.44	0.22
77.00	25.00	0.23
78.00	25.56	0.23
79.00	26.11	0.23
80.00	26.67	0.24
81.00	27.22	0.24
82.00	27.78	0.25
83.00	28.33	0.25
84.00	28.89	0.25
85.00	29.44	0.26
86.00	30.00	0.26
87.00	30.56	0.26
88.00	31.11	0.27
89.00	31.67	0.27
90.00	32.22	0.28

APPENDIX B.

EXAMPLE OF CHECKBOOK SCHEDULING

APPENDIX B
DAILY CHECKBOOK IRRIGATION SCHEDULING PROCEDURE

CALCULATION OF SOIL MOISTURE LOSS

- 1) Enter date in column 1.
- 2) Obtain the previous days' high and low temperatures and enter in columns 2 and 3. Enter the crop coefficient in column 6. For grass at soccer field, use crop coefficient of 0.87.
- 3) Calculate the previous days' average temperature. Average temperature is the average of the previous days' high and low temperature. Enter this value in column 4.
- 4) Determine evapotranspiration potential. Read evapotranspiration potential for the daily temperature from Appendix A. Enter this value in column 5.
- 5) Calculate soil moisture loss by multiplying potential evapotranspiration (column 5) by the crop coefficient (column 6). Enter this value in column 7.

CALCULATION OF SOIL MOISTURE GAIN

- 1) Obtain the previous days' rainfall amount and enter in column 8.
- 2) Determine effective rainfall (amount of rainfall that actually entered the soil) from Table 1 and enter this value in column 9.
- 3) Enter the previous days' irrigation amount in column 10.
- 4) Calculate soil moisture gain by adding effective rainfall to the amount of irrigation (column 9 + column 10). Enter this value in column 11.

CALCULATE SOIL MOISTURE DEFICIT AND DECIDE IF IRRIGATION IS NEEDED

- 1) To soil moisture deficit* subtract soil moisture gain (column 11) and add soil moisture loss (column 7). This is the new soil moisture deficit for this day. Enter this value in column 12.
- 2) Determine if irrigation is needed. If the soil moisture deficit is greater than the preset value*, irrigation is needed.

* Determined at beginning of irrigation season

Example 1: It is April 15th and it is the first day scheduling should begin. The soil moisture deficit was determined to be 0.2 inches the day before. Today's high temperature is 70°F and the low temperature is 45°F. The time of Table 1 is determined to be when the soil moisture deficit reaches 1 inch. The crop coefficient is determined to be 0.2.

Table 1
Effective Rainfall for Different Increments of
Measured Precipitation

Measured Precipitation (inches)	Effective Rainfall (inches)					
	April	May	Jun	Jul	Aug	Sep
0.2	0.10	0.10	0.11	0.12	0.11	0.10
0.4	0.25	0.28	0.32	0.33	0.31	0.27
0.6	0.40	0.46	0.51	0.54	0.50	0.43
0.8	0.54	0.62	0.69	0.72	0.68	0.57
1.0	0.67	0.78	0.86	0.90	0.84	0.72
1.2	0.80	0.92	1.04	1.10	1.03	0.86
1.4	0.94	1.07	1.20	1.22	1.18	1.01
1.6	1.05	1.21	1.34	1.36	1.32	1.12
1.8	1.19	1.35	1.50	1.52	1.47	1.26
2.0 or greater	1.30	1.50	1.66	1.70	1.62	1.40

* less than 0.2 inches use 50%

* less than 0.01 inches assume 0.00 effective

Source : Wyoming Water Resource Center (1983)

APPENDIX B

Example 1: It is April 15th and it is the first day scheduling should begin. The soil moisture deficit was determined to be 0.2 inches the day before. Today's high temperature is 70°F and the low temperature is 48°F. The time of irrigation is determined to be when the soil moisture deficit reaches 1 inch. The crop coefficient is determined to be 0.87.

$$(1) \text{ April 15 - } \frac{70 + 48}{2} = 59^{\circ}\text{F}$$

$$(2) \text{ From Appendix A } ET_{\text{potential}} = 0.2 \text{ inches}$$

$$(3) (.2) * (.87) = .17 = ET_{\text{Actual}}$$

$$(4) \text{ No rain or irrigation, soil moisture deficit} = (.2) + (.17) = .37$$

$$(1) \text{ April 16 - } \frac{75 + 50}{2} = 62.5^{\circ}\text{F}$$

$$(2) \text{ From Appendix A } ET_p = 0.22 \text{ inches}$$

$$(3) (.22) \times (.87) = .19 \text{ inches}$$

$$(4) \text{ No rain or irrigation, soil moisture deficit} = (.37) + (.19) = .56 \text{ inches}$$

$$(1) \text{ April 17 - } \frac{72 + 46}{2} = 59^{\circ}\text{F}$$

$$(2) \text{ From Appendix A } ET_p = 0.2 \text{ inches}$$

$$(3) (.2) \times (.87) = .17 = ET_{\text{Actual}}$$

$$(4) \text{ No rain or irrigation, soil moisture deficit} = (.56) + (.17) = 0.73$$

APPENDIX B

$$(1) \text{ April 18 - } \frac{64 + 38}{2} = 51^{\circ}\text{F}$$

$$(2) \text{ From Appendix A ET potential} = 0.16 \text{ inches}$$

$$(3) (.16) * (.87) = .14 = \text{ET Actual}$$

$$(4) .1 \text{ inches of rain, no irrigation determine effective rainfall from Table } \underline{\hspace{1cm}}. (.1) \times (1/2) = 0.05 \text{ inches}$$

forget ET table

$$(5) \text{ Soil moisture deficit} = (0.73 + .14) - .05 = 0.82 \text{ soil moisture}$$

$$(1) \text{ April 19 - } \frac{76 + 52}{2} = 64^{\circ}\text{F}$$

$$(2) \text{ From Appendix A ET potential} = (.23)$$

$$(3) .23 * .87 = .20 = \text{ET Actual}$$

$$(4) \text{ No rain or irrigation, soil moisture deficit} = (.82) + (.20) = 1.02 \text{ inches}$$

* NOTE: Irrigation must occur tomorrow because the soil moisture deficit is greater than 1 inch.

$$(1) \text{ April 20 - } \frac{72 + 49}{2} = 60.5^{\circ}\text{F}$$

$$(2) \text{ From Appendix A ET potential} = 0.21$$

$$(3) (.21) * (.87) = 0.18 = \text{ET Actual}$$

(.5) x 2 = 1 inch. (Sprinklers will be set with timers to apply the same amount every irrigation). No rain.

$$(4) 1.02 + 0.18 - 1.0 = 0.20 \text{ inches} = \text{soil moisture deficit.}$$

$$(1) \text{ April 21 - } \frac{60 + 40}{2} = 50^{\circ}\text{F}$$

$$(2) \text{ From Appendix A ET potential} = 0.16$$

$$(3) (.16) (.87) = 0.14 = \text{ET}$$

$$(4) \text{ Rain of 1 inch. Effective rainfall} = 0.67 \text{ inches from Table 1.}$$

$$(5) 0.20 + .14 - .67 = -.33$$

* NOTE: A negative soil water deficit cannot exist. Use 0.0 for Column 12.

DATE DAILY
HIGH
TEMP.

1	2
4-14	
4-15	70
4-16	75
4-17	72
4-18	69
4-19	76
4-20	72
4-21	60

CHECKBOOK IRRIGATION SCHEDULING

[illegible]

DATE

DAILY
HIGH
TEMP.

1

2

CHECKBOOK IRRIGATION SCHEDULING .

[illegible]

DATE DAILY
HIGH
TEMP.

1	2

CHECKBOOK IRRIGATION SCHEDULING

[illegible]

DATE DAILY
HIGH
TEMP.

1	2

CHECKBOOK IRRIGATION SCHEDULING

[illegible]

DATE DAILY
HIGH
TEMP.

1	2

APPENDIX D

CHECKBOOK IRRIGATION SCHEDULING

[illegible]

APPENDIX C.

MAINTENANCE AND INSPECTION OF IRRIGATION SYSTEM

IRRIGATION SYSTEM INSPECTION

Sprinkler Heads: Note the following conditions; abnormal pressure at sprinkler head, water pooling, stuck sprinkler heads and clogged sprinkler heads (if no problem, indicate "None"). Other potential problems:

Date _____ Time _____ Location of _____
 _____ Time _____ Problem _____

"4" Mainline: Note the following conditions; Any highly saturated areas along the mainline, any group or series of sprinklers operating at lower than normal pressure. Other potential problems.

Date _____ Time _____ Location of _____
 _____ Time _____ Problem _____

Control Valves: Note the following conditions; any leaky or malfunctioning valves. Other potential problems.

Date _____ Time _____ Location of _____
 _____ Time _____ Problem _____

Flow Meter: Note the following long-term and short-term meter readings.

Initial Meter Reading _____ Date _____ Time _____
 Days since last reading _____

APPENDIX C.

A fifteen minute reading should be taken with the system working at full capacity and at exactly 15 minute intervals.

Meter reading at the beginning of a 15 minute period _____.

Meter reading at the end of a 15 minute period _____.

Gallons used _____

Date _____ Time _____

Maintenance of System: Record any system maintenance and/or problem corrections.

Type of Maintenance Correction _____

Location _____

Date _____ Time _____

If water loss has occurred, estimate amount and time of loss:

Amount of Loss (gallons) _____

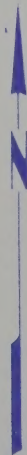
Date loss began _____ Time _____

Date of Correction _____ Time _____

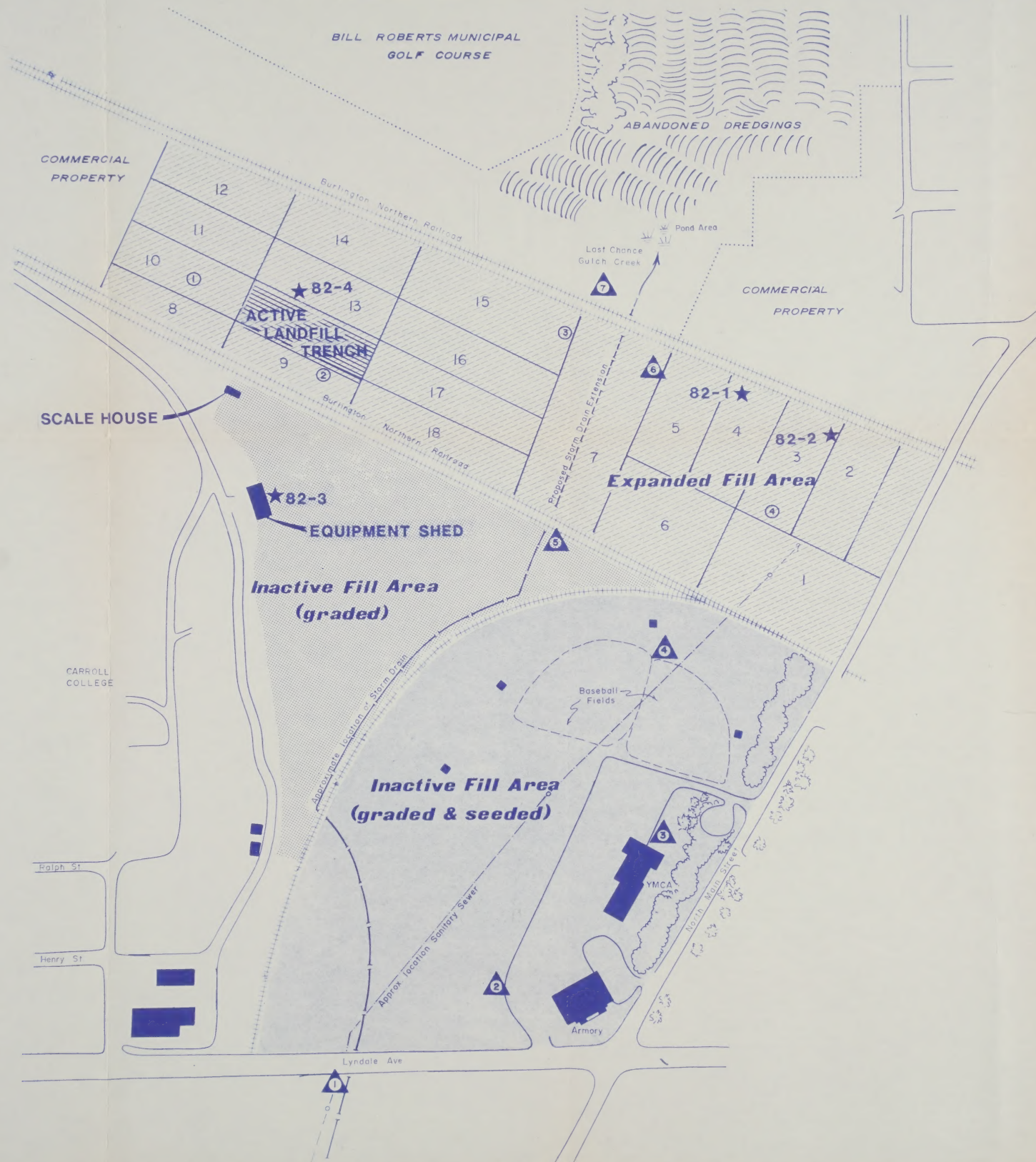
Name of Inspector _____

Date Inspected _____

Henry St



LEGEND



LEGEND

- ① Uncased Borehole
- ▲ Monitoring Wells
- ★ Monitoring Wells Completed in November, 1982
- | Disposal Trench Area
- Proposed Neutron Probe Access Ports

SCALE

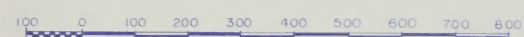


PLATE 1
PLAN MAP OF HELENA MUNICIPAL LANDFILL
AREA SHOWING MONITORING WELL LOCATIONS
AND PROPOSED NEUTRON PROBE ACCESS PORTS

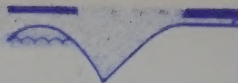
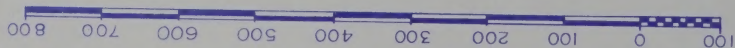


PLATE 1
 PLAN MAP OF HELENA MUNICIPAL LANDFILL
 AREA SHOWING MONITORING WELL LOCATIONS
 AND PROPOSED NEUTRON PROBE ACCESS PORTS



SCALE

- ① Uncased Borehole
- ▼ Monitoring Wells
- ★ Monitoring Wells Completed in November, 1982
- | Disposal Trench Area
- Proposed Neutron Probe Access Ports

